

# METAL CASTING

## Project Fact Sheet



## MODELING THE MECHANICAL PERFORMANCE OF DIE CASTING DIES

### BENEFITS

This project will advance the state-of-the-art in computer modeling and simulation of die casting dies. It will address and resolve die design problems and in practical and efficient ways that are not currently available for the industry. Both first shot success and dimensional controllability are critical for die casters. A better understanding of how the machine/die/process combines to produce the part, will lead to the benefits of reduced lead time and dimensional quality. This will significantly reduce energy consumption associated with die tryout resulting in energy savings and reduced environmental emissions.

### APPLICATIONS

The results from this project can be applied throughout the die casting industry. A design methodology will be developed from this project for die design with computer simulations. Relevant design data and procedures will also be developed for use without the computer simulations.

## NEW TOOLS TO ADDRESS DISTORTION ARE CRITICAL TO FIRST PART SUCCESS AND ELIMINATING/REDUCING VARIABILITY

The majority of die casting computer modeling work focuses on thermal or filling issues including solidification. Although the simulation of mechanical and thermal load effects is critical for high pressure die casting and for squeeze casting it is not yet addressed by commercial casting design packages. In an attempt to resolve this, stress analysis packages for the casting are beginning to be used. But they are based on the nominal part geometry (as defined by the CAD model) and not the actual part shape at ejection. This is not a reasonable assumption for die casting. Due to the clamping and operating pressure involved, the mechanical performance of the die and machine must be considered in order to better understand the part ejection conditions.

As a direct extension of an existing projects "Die Deflection Modeling: Empirical Validation and Technology Transfer", researchers from Ohio State University will further advance the state of the art in computer modeling and simulation to solve die casting design problems in practical ways. Key relationships among the design variables will be determined, and a design methodology will be established. This work will lead to a better understanding of how to design dies to meet clamping, thermal, and pressure loads.

### DIE AND MACHINE DISTORTION

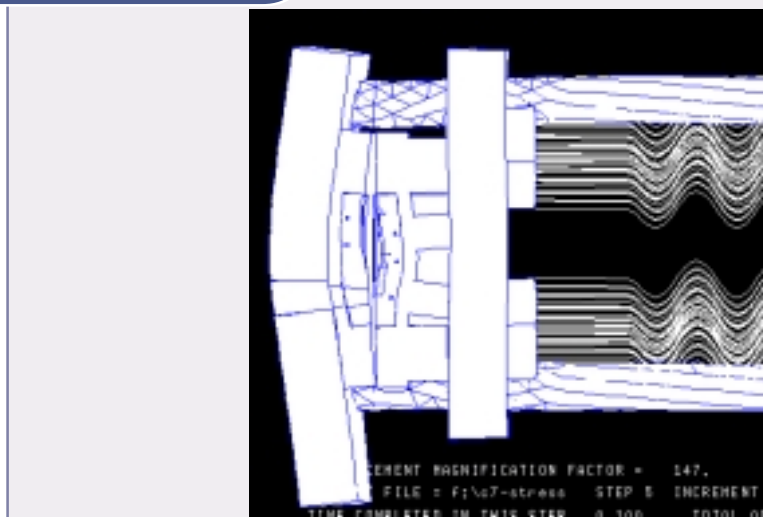


Image shows a magnified display and die and machine distortion under load for one of the worst cases analyzed. The central part of the image shows significant cavity distortion that would results in distorted part shapes.



## Project Description

**Goal:** The goal of this project is to assemble data and report results on development methods which can be applied to design better running die casting dies. By incorporating design methods and computer modeling in the design phase, the goal of this project is to reduce the number of test-rework-repair iterations necessary to put a new die into service.

## Progress and Milestones

This two year project was awarded in August 2000. Planned tasks include:

- **Computational Experiments** – Computational experiments will be designed to study ejector die configurations, cover/ejector die relationships, effects of slides, effects of toggle placement, multi-cavity effects, and cycle-to-cycle variation.
- **Pressure Spike Modeling** – An extensive literature review will be conducted first and an engineering approach to this problem will be organized. A computer model will be developed and utilized. The relative importance of the impulse load compared to other loads will be evaluated and effects on the final part dimensions will be estimated.
- **Design Guidelines** – All the deflection modeling results will be summarized in a form useful to the die designers.
- **Laboratory Experiments** – Experiments with small dies, large dies, and dies with multi-cavities will be performed to compare with simulation results.



### PROJECT PARTNERS

Ohio State University  
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North American Die Casting Association  
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AMCN  
Briggs & Stratton  
Chicago White Metal  
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DCD Technologies  
Exco Engineering  
Flow Science Inc.  
Ford-Rawsonville Plant  
General Die Casters  
GMPT Ypsilanti  
JL French  
Lester Precision Die Casting  
Magma Foundry Technologies  
Prince Machine  
R&S Design  
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